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ALBERTOSAURUS ARCTUNGUIS

A New Species of Therapodous Dinosaur from the Edmonton Formation of Alberta

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Introduction

The only large carnivorous dinosaur recorded from the Edmonton formation is that which Cope and Lambe ascribed to *Dryptosaurus incrassatus* Cope. This species was founded by the former author on teeth from the Judith River formation of Montana and referred, in the first instance, to the genus *Laelaps;* later he assigned a nearly complete dentary to the same species.[1] At a later date Cope described two skulls from the Edmonton formation, referring them to the same species.[2]

Dr. Henry Fairfield Osborn has pointed out that *Dryptosaurus*, a name proposed by Marsh to replace *Laelaps*, as the latter was preoccupied, should be reserved for the Edmonton species and that the several Judith River species should be referred to *Deinodon* Leidy.[3] Lawrence M. Lambe suggested, further, that the original teeth and dentary from the Judith River beds should be ascribed to *Deinodon horridus* Leidy, and that the two Edmonton skulls should be considered as the types of *Dryptosaurus incrassatus*.[4] More recently, Dr. Osborn, admitting the type character of the Edmonton skulls, proposed for them a new generic and specific name *Albertosaurus sarcophagus*, reserving *Dryptosaurus incrassatus* for the Montana teeth and dentary. In this article Dr. Osborn does not refer to the identity of *Dryptosaurus incrassatus* with

[1]Proc. Acad. Nat. Sci., Philadelphia, Vol. XXVIII, pp. 248-340.
[2]Proc. Am. Phil. Soc., Vol. XXX, p. 240, 1892.
[3]Geol. Surv. Can., Cont. Can. Pal., Vol. III, Pt. II, 1902.
[4]Geol. Surv. Can., Cont. Can. Pal., Vol. III, Pt. III, 1904.

Deinodon horridus, but he states that the genus *Dryptosaurus* (*Laelaps*) "is probably a different animal, but not as yet distinguished from the previously described *Deinodon*." Dr. Osborn evidently holds that a name founded on certain material makes that material the type, and that even the author cannot transfer that name to other material which later investigations shall have shown to be non-cospecific. If the original *Dryptosaurus incrassatus* fragments are cospecific with *Deinodon horridus*, the former name ceases to exist and cannot be transferred to the Edmonton skulls.[5]

Lambe (*op. cit.*) gives a full account of the material in the possession of the Geological Survey of Canada: this consists of:—

Larger head, originally described by Cope.
Smaller head, considered as a cotype.
Distal end of tibia with part of astragalus, associated with the smaller head.
Left metatarsal IV, associated with smaller head, described by Lambe as right metatarsal II.
Three ungual phalanges associated with smaller skull and ascribed to the manus.
Part of left ilium with neural arches and spines of crushed sacral vertebrae, associated with smaller skull.

The University expedition of 1923 obtained part of a skeleton of a large carnivorous dinosaur in the Edmonton formation, on the west side of the Red Deer river, two and a half miles above Bleriot ferry at an elevation of 100 ft. above the water. This skeleton consists of the following parts:—

Part of the vertebral column showing posterior dorsal vertebrae, but with the sacral vertebrae hidden under the ilium.
Scapula, coracoid, and complete left fore limb.
Left pelvic girdle, almost perfect except for part of ilium.
Left hind limb, lacking the phalanges of the pes except III^1, III^2, III^3.
Dorsal and abdominal ribs.

Lacking the head, the identification of the species depends, in the first place, on a comparison with the fragmental material described by Lambe. To this end Dr. E. M. Kindle, palaeontologist to the Geological Survey of Canada, has kindly given me the opportunity to examine the material

[5] Bull. Am. Mus. Nat. Hist., Vol. XXI, Art. II, 1905.

described by Lambe. In a general way the result of this comparison is as follows:—

The astragalus and distal end of the tibia of our form differ slightly from the corresponding parts of Lambe's type, but, in view of the state of preservation, there is no justification for the erection of a new species.

The ungual phalanges of the manus of the type are heavier, differently indented, and much wider than those of our specimen. The triangular outline of the articular surface described and figured by Lambe is essentially different from the elongated and narrow surface in our form. If Lambe's ungual phalanges really belong to the manus of his *Dryptosaurus incrassatus*, there can be no question of the specific separation of our specimen.

The sacral spine affords no means of comparison, as these structures are not revealed in our specimen, but by comparison with our posterior dorsals, Lambe's sacral spine is much larger than would be expected in our form.

The best means of comparison is afforded by the metatarsal described by Lambe as metatarsal II of the right limb. As metatarsals II and IV are very much alike, Lambe's interpretation is easily pardonable; but with our complete metatarsus for comparison, I am of opinion that the type bone is really metatarsal IV of the left limb. On this assumption, Lambe's account must be modified as follows:—"The metatarsal figured in plate VII also goes with the smaller skull; it is remarkable for its length and slenderness and is regarded as the fourth of the left limb. It is laterally compressed above, has a straight shaft, and near its lower end is bent suddenly outward away from Mt. III. The shaft is narrowly rounded in front and flattened on the side that would come next to metatarsal III indicating a close approximation of the bones of the metatarsus to one another. This lateral flattened surface is rugose and meets the posterior surface, which is also flat, in a decided angulation that is conspicuously prominent (at *a* fig. 18, plate VII) above the sudden out-turn of the bone below. The proximal articular surface is flat and anteroposteriorly elongated with a length about twice the width;

the distal articular surface is rounded and produced well up in front and behind, pointing to a considerable flexibility at this joint. There are well-marked vascular grooves and pits in both articular surfaces. Internally the distal end is deeply excavated; posteriorly, a shallow groove (*b* fig. 18) passes upward from the articular surface; viewed from below it is semicircular in outline, flat internally, and curved on the outer side. On the outer posterior surface of the shaft, below its midlength, there is a roughened vertical groove."

Owing to the imperfection of the upper middle fourth of Lambe's bone, this part of his drawing is too evenly rounded; the sharp upstanding edge to the left of *c* should be continued upwards towards the left edge to near the point *e*. There should be a thin point on the left of the figure about an inch below the upper end.

Lambe's interpretation of the parts will be considered later. In general form our metatarsal IV closely resembles Lambe's type, but despite allowance for deformation in both bones, there are differences of sufficient moment to constitute our specimen a distinct species.

In the first place, our bone is considerably longer and heavier, but this might be ascribed to a mere difference in growth. The proximal part of our specimen is rather badly crushed, and I should hesitate to found specific difference on this part. The flattened internal face of our bone is much greater in antero-posterior diameter than in Lambe's type, but this difference may be due to the very bad condition of the type bone in this region.

The postero-external groove is longer and less roughened in our specimen, but this difference might be overlooked.

In the distal end of the bone, however, there are differences which seem incompatible with specific identity. In the first place, the articular surface, semicircular in Lambe's type, is subquadrate in our bone. Posteriorly, the articular surface is drawn out to two distinct condyles separated by a deep groove, which is almost absent in Lambe's type. The absence of this groove gives Lambe's bone the characteristic semicircular appearance.

The roughened protuberance (*d*) which Lambe interpreted as the point of attachment of the distal end of metatarsal I is entirely absent in our bone, and the external, elongated, roughened area above the articular surface (shown above the letter *d* in Lambe's figure) is likewise absent, the surface of our bone in this region being smooth and normal. Despite the greater size of our bone, the girth above the articular surface is less than in Lambe's type, owing to the absence of these protuberances. It seems impossible to overlook these differences, unless we assume that the peculiar condition of the type is due to exostosial growth after injury in life, a conclusion not at all unlikely from the condition of the bone.

In view of the above differences from *Albertosaurus sarcophagus* (*Dryptosaurus incrassatus*) Cope, Lambe, it seems necessary to describe our form as a new species. It is of course impossible to establish the congeneric character of the two species. For the present, however, it seems advisable to ascribe our form to *Albertosaurus*, as the known differences seem scarcely sufficient to justify a new genus from the same horizon as *A. sarcophagus*. It is very unlikely that our species could be ascribed to the Belly River *Gorgosaurus*, as there are essential differences in the pelvic girdle and in the scapula. The humero-femoral ratio, also, is lower in our species (.29 to .31), indicating a still more reduced fore-limb.

If we accept Dr. Osborn's conclusion, *Dryptosaurus incrassatus* becomes *Albertosaurus sarcophagus*. This species is known with certainty only by the two heads; the associated material is doubtful. The identity of our form with Lambe's type is not impossible, as the erection of the new species depends on the comparison of a metatarsal in which the pathological condition of the type may account for the differences, and on a comparison of ungual phalanges of which Lambe's types may not really belong to his species. It is readily admitted, therefore, that our form is possibly, but not, probably, identical with *Albertosaurus sarcophagus*. In any event, the present contribution is justified, whether as the description of a new species, or as the description of certain skeletal elements of *Albertosaurus sarcophagus*.

DETAILED DESCRIPTION

VERTEBRAL COLUMN

The posterior dorsal vertebrae, the sacrals, and the proximal caudals are alone preserved. All are crushed, deformed, and in some cases even mashed, making detailed description impossible. In *Gorgosaurus*, Lambe recognizes eleven dorsals, one lumbar, and five sacrals. Osborne assumes eleven dorsals and makes no mention of a lumbar in *Tyrannosaurus*. Gilmore gives fourteen dorsals, the last bearing a rib, and five sacrals for *Antrodemus* (*Allosaurus*), and for *Ceratosaurus* fifteen dorsals, five sacrals, and no true lumbar, although the first pre-sacral bore no rib and was attached to the ilium by its transverse process.

Following Lambe's interpretation, but without any direct evidence, our specimen shows the posterior four dorsals (first imperfect), one lumbar, five sacrals, and three caudals.

The dorsal centra are slightly amphicoelous, and strongly excavated laterally and ventrally, but the deep cavity on the lateral face of the centrum as in *Gorgosaurus* does not seem to occur. The transverse processes in the anterior vertebrae are directed back and up, but they gradually assume the horizontal position posteriorly. The process is a wide, flat flange, buttressed behind by a heavy vertical plate running down towards the posterior rim of the centrum; in consequence, the process seems to be excavated antero-inferiorly by a deep recess.

The neural spines are upstanding with a backward slope; they do not seem to show a central smooth portion and a peripheral furrowed extension as in *Gorgosaurus* and *Antrodemus*. The condition of preservation, however, makes this very uncertain. The isolated spine ascribed by Lambe to the sacrum of his type is very broad (120 mm. proximally and but little less toward the tip), and is quite different from the dorsal spines of the present species.

In no case are the dorsal vertebrae good enough to enable one to make out the peculiarities of articulation.

As far as can be observed, the lumbar vertebral centrum

is like that of the posterior dorsals; the transverse process is horizontal and lies within the anterior flange of the ilium. Whether it is attached or merely contiguous by pressure cannot be determined.

The five fused sacrals are not well exposed. The centra, as far as can be observed are similar to those of the posterior dorsals. The spines are mashed, and no evidence is available of their fusion as in the other great carnivorous forms.

The caudal centra, also, are slightly amphicoelous, and concave ventrally and laterally. They are considerably flattened, making measurements, other than of length, very doubtful. The height is probably greater than the width, the posterior face of the first caudal being 185 mm. high.

COMPARATIVE MEASUREMENTS OF VERTEBRAE

	A. arctunguis mm.	*Gorgosaurus* mm.	*Tyrannosaurus* mm.	*Antrodemus* mm.
Dorsal centra, length at midheight:				
9 (4th presacral)	110	—	130	94-96
10	120	143	145	93-99
11	125	150	—	99
Lumbar centrum (1st presacral), length	130	—	170	102-106
Five fused sacrals, length	675	690	940	536-575
Fifth sacral centrum, length	125	160	—	104-132
Caudal centra, length:				
First	130	—	—	121
Second	133	—	—	123
Top of neural spine to upper surface of base of transverse process:				
Ninth dorsal	160	145	—	—
Tenth	170	155	—	—
Eleventh	170	160	—	—
Top of neural spine to bottom of centrum:				
Ninth dorsal	405	295	—	332-365
Base of spine to tip of transverse process:				
Ninth dorsal	105	—	—	—
Tenth	110	—	—	—
Eleventh	113	—	—	—

These measurements of our form indicate an animal generally smaller than *Gorgosaurus*, and considerably smaller than *Tyrannosaurus*, but larger than *Antrodemus*. Despite the smaller size, the height of the neural spines and the total height of vertebrae is greater than in *Gorgosaurus*. The spines do not seem to show the central smooth part and furrowed periphery seen in all the other species, nor does the large isolated spine associated by Lambe with the type of *A. sarcophagus*.

The only chevron preserved is the first, found in position between caudals 1 and 2. This bone is very like that figured by Lambe for *Gorgosaurus*. The breadth at midlength is about the same in both species (40 mm.). The notch between the rami is slightly less deep in our form and the sulcus below the notch does not extend as far down on the posterior edge.

DORSAL RIBS

The sixth to eleventh dorsal ribs of the left side are present in an indifferent state of preservation, and four other anterior ribs in a fragmental condition. In all observable cases the tuberculum is scarcely defined, and the bone shows a long sweeping curve from the capitulum to the end. Below the tuberculum, the upper surface is convex transversely. The anterior surface is excavated by a decided groove that gradually assumes a more and more ventral position distally, passing to the under side of the rib near the tip. A somewhat similar groove shows on the posterior side.

COMPARATIVE MEASUREMENTS OF DORSAL RIBS

	Albertosaurus arctunguis	*Gorgosaurus*
Length along curve, tuberculum to end:		
Seventh	840	978 est.
Eighth	725	863 est.
Ninth	580	711 est.
Tenth	520	—
Eleventh	465	—

It is unfortunate that in no case is an exact comparison possible, as the ribs best preserved in our form are those deficient in Lambe's.

PECTORAL GIRDLE

The *scapula* (Fig. 1) is very like that of *Gorgosaurus* or of *Tyrannosaurus;* the shaft-like median part is similarly elongate, but the distal blade-like part is inflected forward farther than in *Tyrannosaurus* and much farther than in *Gorgosaurus.*

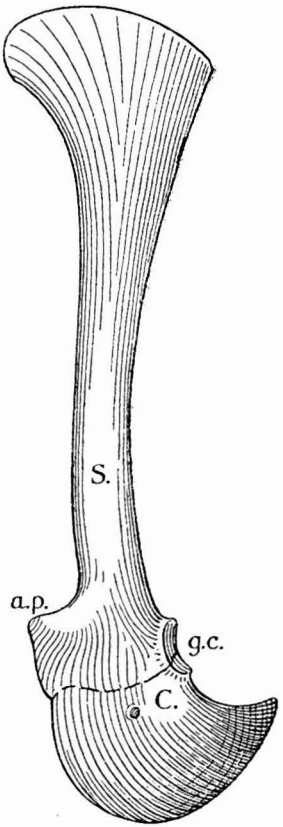

FIG. 1—Left scapula and coracoid, 1/8 natural size. S, *scapula*; C, *coracoid*; a.p, *acromial process*; g.c, *glenoid cavity.*

In this respect *Gorgosaurus* resembles *Antrodemus*, and *Albertosaurus* resembles *Tyrannosaurus*. The expanded proximal end has the same squarish shape as in the two other genera, but it is less extended forward; in consequence, the scapulo-coracoidal suture is relatively shorter.

The *coracoid* is not well preserved in either *Tyrannosaurus* or *Gorgosaurus*. Lambe's figure (*op. cit.*, p. 49) indicates a bone of quadrangular outline, but a well-preserved specimen in the Royal Ontario Museum has a much more rounded inferior border and a more pronounced infero-posterior point. The coracoid of *Albertosaurus* is similarly rounded and pointed as in *Antrodemus*. The coracoidal foramen is small and situated near the suture. The glenoid cavity is made up almost equally by the scapula and the coracoid.

COMPARATIVE MEASUREMENTS OF SCAPULAE AND CORACOIDS

	Albertosaurus mm.	*Gorgosaurus* mm.	*Tyrannosaurus* mm.	*Antrodemus* mm.
Scapula and coracoid, length	830	1086	—	795
Scapula:				
Length	740	876	950	652
Width at upper end	225	175	—	145 est
Width, ¼ of length from suture	63	56	—	52
Thickness at this point	28(?)	40	—	—
Width, proximal end	150	—	—	175(?)
Scapulo-coracoidal suture	125	166	—	—
Coracoid:				
Length	148	210	—	120
Maximum, point to anterior of suture	245	—	—	—

FORE LIMB

The *humerus* (Fig. 2) is even more reduced than in the other great carnivorous dinosaurs. The humero-femoral ratio is 0.297, as compared with 0.311 for *Gorgosaurus* and 0.364 for *Antrodemus*. The proximal part of the bone is crushed, but the general condition is sufficiently good for accurate measurement except at the upper end.

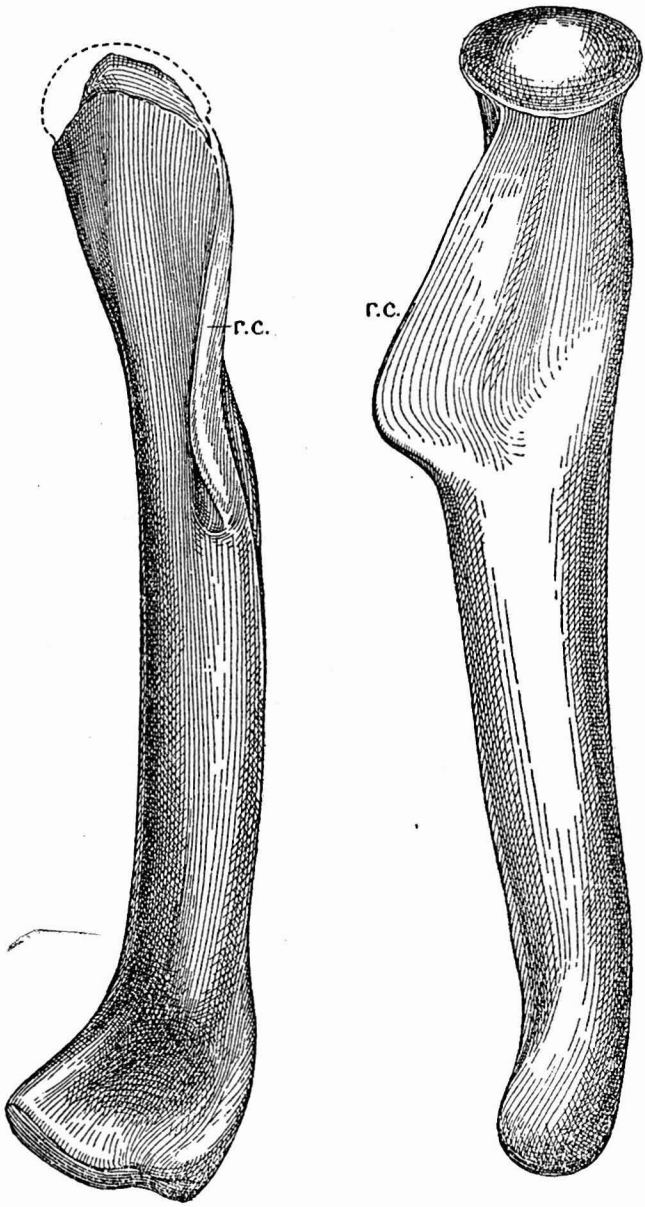

FIG. 2—Left humerus, ½ natural size. Left figure, anterior view; right figure, external view. r.c, *radial creat.*

The bone is slightly bowed outward, and inflected forward and inward at the distal end. The deltoid crest is prominent, thin, and upstanding, and is disposed almost at right angles to the distal expansion of the bone. Below the crest, the cross section is elliptical with the greater diameter antero-posterior. Distally the cross section gradually becomes sub-circular, and still lower it again becomes elliptical, but with the greater diameter in the transverse plane.

The distal expansion is inflected quite strongly inward and somewhat less distinctly forward. Both anterior and posterior faces show depressions above and between the condyles, the anterior being more pronounced. The articular surfaces are convex antero-posteriorly and extend well up in front.

This bone resembles closely the humerus of *Gorgosaurus;* it is much more slender than that of *Tyrannosaurus*, and it is much less expanded, proximally and distally, than the corresponding bone of *Antrodemus*.

The *ulna* (Fig. 3) is a short and fairly stout bone, sub-circular in the lower part of the shaft, but transversely compressed and greatly expanded in the opposite plane above. The expansion is carried up posteriorly to form a prominent olecranon process that is not sharply defined from the articular surface. This surface is a wide, sweeping concavity, narrow, and slightly convex transversely.

The posterior edge of the bone is almost straight up to the point where it turns forward into the olecranon. The anterior edge is concave, sweeping upward from the shaft to a sharp angle with the proximal articular surface, and downward to a less pronounced distal expansion.

The extreme flattening of the proximal end of the bone may be due, in part, to compression, but there is no reason to assume a triangular cross section as described by Lambe for *Gorgosaurus* and by other authors for most dinosaurs. The absence of the usual, anterior ridge that gives the triangular cross section to this part of the bone occasions the failure of the usual hollow for the head of the radius. There is, however, a protuberance on the antero-lateral face, which, if more

extensive, would determine the usual hollow between itself and the internal edge. In the extreme flattening of the proximal part of the bone and in the absence of the anterior ridge the humerus of *Albertosaurus* is remarkably like that of *Thescelosaurus*.

The distal expansion is but slight; it has a sub-triangular cross section with the greatest diameter at an angle of about

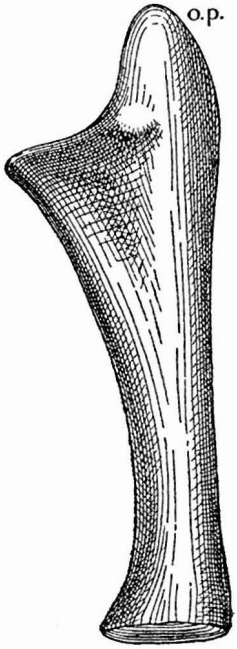

FIG. 3—Left ulna, antero-external view, ½ natural size. o.p, *olecranon process.*

45° with the proximal expansion. Orienting the bone in such manner that the olecranon is externo-posterior in position, the greatest diameter of the distal end is antero-posterior. The internal face is excavated, the antero-external face is convex and passes convexly into the postero-external face which is slightly excavated. The distal articular surface is convex and extends well up on the postero-internal point of

the triangular bone. This point is the th...nest and best defined.

The *radius* (Fig. 4) is a very simple bone, slightly expanded proximally and less distally; it is so badly crushed that its cross section cannot be determined with any degree of accuracy.

Three small *carpals* are present. The *radiale* seems to be the largest element; it is of flattened ovoid form, 18 mm. by 20 mm. and about 12 mm. thick. The *intermedium* is of

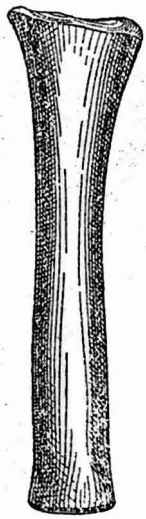

FIG. 4—Left radius, anterior view, ½ natural size.

similar lateral dimensions, but it is much thinner (12 mm.). The ulnare is discoidal, about 18 mm. in diameter, flat above and convex below. The identification of these small elements is attended with some doubt; their position, however, leads to the above interpretation. The ulnare lies beneath the antero-internal face of the ulna and is closely applied to that bone by its upper, flat surface. The radiale lies directly beneath the radius, 10 mm. from the ulnare. The intermedium lies beneath this interspace and is overlapped more

by the ulnare than by the radiale. None of the smaller carpalia were observed.

Metacarpals are preserved only for digits I and II, and, as in *Gorgosaurus*, there is no evidence of other digits having been present.

Metacarpal I is very short, only about half the length of metacarpal II. Both bones are too badly crushed for detailed description, but they show evidence of proximal expansions with flat articular surfaces. The distal expansions show two condyles with a well-marked groove between in both bones. They have well-marked lateral pits both internally and externally. The distal articular surfaces indicate free movement, as they are well rounded and extended upward both before and behind.

The first digit has two phalanges, the distal a claw; the second digit has three phalanges, the distal a claw. The proximal phalanx of the first digit (Fig. 5) is expanded above

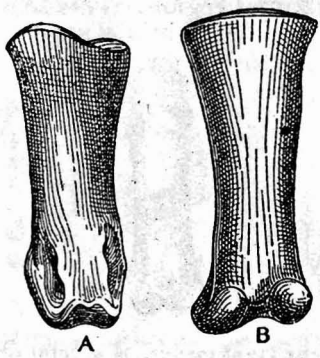

FIG. 5—Left phalanx I^1 of manus, ½ natural size. A, anterior view; B, posterior view.

and presents an articular surface concave transversely. The distal end is less expanded and marked by strong lateral pits. A distinct feature is the strong outward twist of the bone distally, which must have caused the claw to strike inward. The outer condyle, also, is larger than the inner which would tend to increase the inward turn of the claw.

The first phalanx of the second digit (Fig.) is almost as stout as that of the first, but it is only about half the length and entirely without the twist. The second phalanx of digit II (Fig. 7) is medium in length, lighter, and almost symmetrical.

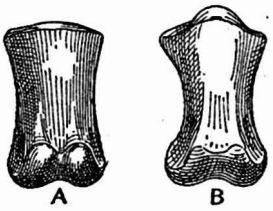

FIG. 6—Left phalanx II[1] of manus, ½ natural size. A, anterior view; B, posterior view.

The ungual phalanges (Figs. 8 and 9) are well preserved in both digits; that of the first is somewhat larger, but there is little difference in the two bones. Both claws are narrow and deep in the proximal region. This feature may be due in

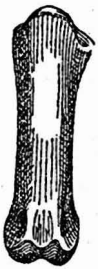

FIG. 7—Left phalanx II[2] of manus, ½ natural size. Dorsal view.

part to compression, but there is, nevertheless, a wide departure from the triangular type of claw described by Lambe for *Albertosaurus sarcophagus*. The articular surface is narrow transversely and high vertically; a medial line forms a slight sigmoidal curve. There is little contraction of the bone distal to the articular margin, but it is decurved and narrows gradually to a point. The proximal edge is deeply notched below the articular surface, and from the notch a lateral

groove runs to the end of the bone. The internal and external aspects are essentially the same, not as in *Thescelosaurus*, where there is a decided difference.

These unguals differ from those described by Lambe for *A. sarcophagus*, not only in their narrow, compressed charac-

FIG. 8—Left phalanx I^2 of manus, ½ natural size. Internal view.

ter, but in the more pronounced proximal, ventral notch and the consequent, backwardly-directed point. Further, in our form the articular surface is almost at right angles to the axis of the bone, whereas in Lambe's unguals this surface is

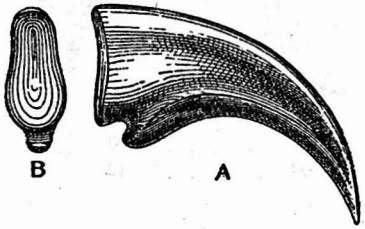

FIG. 9—Left phalanx II^3 of manus, ½ natural size. A, internal view; B, proximal view.

inclined down and forward. The depression of the tip of the claw is largely effected by its curved shape, whereas in Lambe's type this depression is brought about, at least in part, by the inclined articulation. The claws in both species seem to be similarly *depressed*, but in the present species they are more *decurved*.

The peculiar ulna, its relation to the radius, and the relation of both these bones to the humerus indicate that the

whole fore limb was designed for inward and backward movement, rather than for movement in the antero-posterior plane.

COMPARATIVE MEASUREMENTS OF THE FORE LIMB

	Alberto-saurus mm.	*Gorgo-saurus* mm.	*Tyranno-saurus* mm.	*Antro-demus* mm.
Humerus:				
Length	303	324	380 (?)	310
Width, transverse, proximal	40 (?)	55	—	118
Width, transverse, distal	58	64	—	100
Width across deltoid crest	65	—	—	—
Thickness, outer condyle	33	—	—	—
Thickness, inner condyle	23	—	—	—
Ulna:				
Greatest length	163	180	—	263
Greatest diameter, proximal	53	55	—	90
Greatest diameter, distal end	37	34	—	55
Radius:				
Greatest length	136	156	—	222
Greatest width, proximal	36	37	—	56
Greatest width, distal	—	30	—	40
Metacarpal I:				
Length	40	48	—	73
Width at midlength	23	22	—	35
Width, beneath, distal	25	26	—	36
Metacarpal II:				
Length	80	98	—	122-125
Width, beneath, proximal	42	32	—	56-63
Width, beneath, distal	28	27	—	46
Phalanges:				
I^1—length	85	98	—	136-138
width, beneath, proximal	28	30	—	—
width, beneath, distal	28	25	—	—
I^2—length, along upper curve	115	95	—	118-120
height of articular facet	42	36	—	—
II^1—length	45	57	—	94
width, proximal	30	32	—	—
II^2—length	70	83	—	102
width, beneath, proximal	20	30	—	—
width, beneath, distal	18	24	—	—
II^3—length, along upper curve	100	—	—	95
height of articular facet	32	—	—	—

PELVIC GIRDLE

The general outline of the *ilium* (Fig. 10) is strikingly oblong, drawn down anteriorly to a decurved point and medially to the two peduncles. Except in the acetabular region,

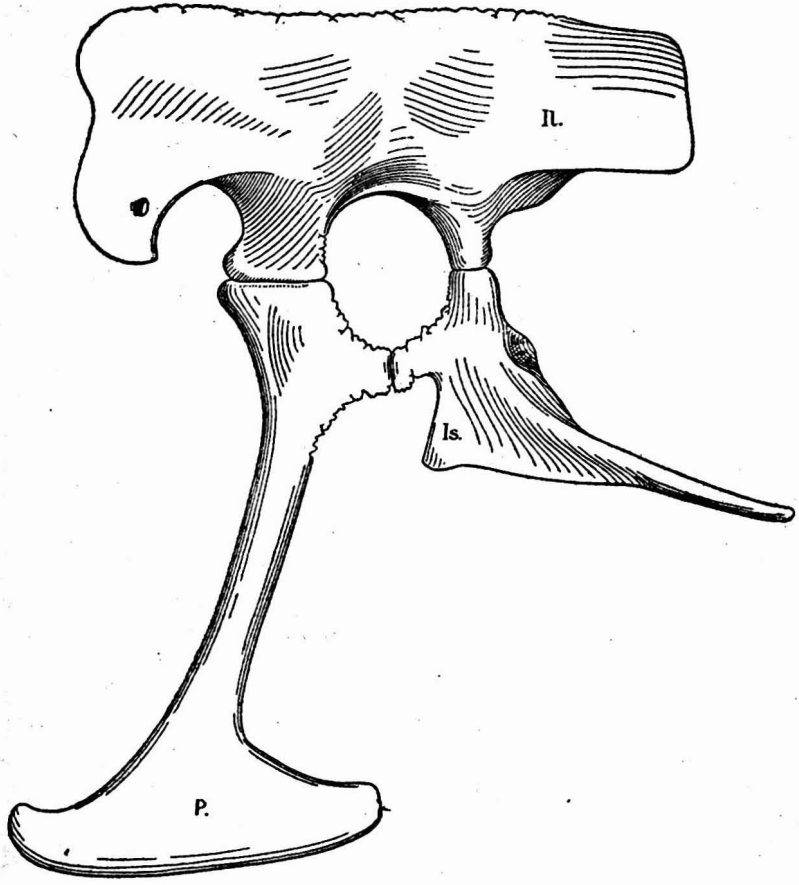

FIG. 10—Left pelvic girdle, 1/12 natural size. Il., *ilium*; Is., *ischium;* P, *pubis*.

the bone is thin—not more than a few millimetres thick in places. The outer surface is essentially flat, but, owing to its thinness, the bone conforms with the underlying vertebrae

making observations as to its surface characteristics somewhat doubtful.

The upper edge is broken, but it is probably slightly convex and somewhat sinuous. The anterior edge is distinctly undulating, and the strong decurved point extends well below the average inferior margin of the bone. The posterior edge is straight and nearly at right angles to both the superior and inferior edges of the posterior blade.

The middle of the acetabular rim is behind the mid-point of the bone. Anteriorly the rim continues downward into the strongly developed pubic peduncle, which is elongated antero-posteriorly and somewhat excavated on its outer face. The anterior margin of this peduncle is concave in lateral view, and it extends upward in such manner that it is overlapped by the preacetabular portion of the blade, which makes a sweeping curve from the decurved point to the place of merging with the outer surface of the peduncle. In the decurved point there is a peculiar foramen, not seen in the related species, passing through the bone in an oblique manner from the front backward. This aperture is 35 mm. by 25 mm. and is situated 20 mm. above the inferior margin, and 68 mm. from the anterior edge. This foramen may be of specific significance, but, more probably, only individual.

The ischiac peduncle is much narrower antero-posteriorly than the pubic peduncle, and the acetabular rim is interrupted above the peduncle by a distinct sulcus cutting through the rim and extending forward on the articular surface of the acetabulum. The posterior margin of the ischiac peduncle extends back and up as an extensive flange internal to the posterior blade of the bone, which it joins some distance up. This arrangement gives the posterior part of the ilium the appearance of being deeply excavated inferiorly as described by Lambe for *Gorgosaurus*.

The ilium of *Albertosaurus* is distinctly more squarish in outline than in either *Gorgosaurus* or *Tyrannosaurus;* compared with the former genus the following differences are distinct:—

1. The bone is more symmetrical and more nearly oblong, as the posterior blade is wider and the anterior blade narrower.

2. The middle of the acetabular rim is posterior to mid-length, while in *Gorgosaurus* it is distinctly in advance.

3. The presence of a foramen in the preacetabular blade.

4. The anterior decurved point does not reach to a line joining the sutural surfaces of the peduncles; in *Gorgosaurus* it extends below this line.

The *ischium* (Fig. 10) is wide and flat proximally, and is drawn out anteriorly to a prominent obturator process, which is separated from the sutural end of the bone by a distinct notch or recess. Distal to the process, the bone narrows rapidly in a sweeping, concave curve to its thin extremity. The ischium may be regarded as composed of two parts—a rod-like shaft and a proximal, anterior expansion therefrom. In the proximal third of the bone these two parts are merged; in the middle third, they are separated by a wide concavity on the outer surface; in the distal third, this concavity becomes a distinct groove which turns inward to a ventral position, and finally to an almost internal position, thus giving to the end of the bone a somewhat twisted appearance. The tips of the two ischia were undoubtedly in contact, but there is no evidence of co-ossification.

The sutures with the ilium and with the pubis are not well shown and the acetabular rim is destroyed, but the arrangement of the parts seems to be quite normal. The posterior border, a short distance below the iliac suture, is marked by a sharply defined muscle-scar.

This bone resembles the ischium of *Gorgosaurus* much more closely than that of *Tyrannosaurus*.

The *pubis* (Fig. 10) is very similar to that of *Gorgosaurus* or of *Tyrannosaurus*, but it is relatively longer, and the "foot" is more massive. Measured in a straight line from the middle of the suture with the ilium to the anterior extremity, the bone is 50 mm. longer than the pubis of *Gorgosaurus*, although the general proportions of the animal are less.

The bone is expanded antero-proximally for sutural union with the pubic peduncle of the ilium; the anterior edge forms a sweeping, concave curve, and the external face a similar, but more abrupt, curve to the suture. The detail of the union with the ischium is not well shown.

Below the iliac suture is a prominent, external, longitudinal ridge; anterior to this ridge, the surface is convex; posterior to the ridge, it is shallowly concave.

The shaft is directed downward and forward, but it is bowed backward and inward. The two pubes become contiguous 400 mm. above the ventral edge of the foot (580 mm. along curve from anterior tip of foot). Above the point of union the cross section is ovate with the narrow edge inward. Below the point of union the anterior edges become thinner

COMPARATIVE MEASUREMENTS OF BONES OF PELVIC GIRDLE

	Alberto-saurus mm.	*Gorgo-saurus* mm.	*Tyranno-saurus* mm.	*Antro-demus* mm.
Ilium:				
Extreme length	980	984	1515	672-720
Length in front of middle of acetabulum	505	457	—	—
Length behind middle of acetabulum	475	527	—	—
Height of anterior blade	400	438	—	—
Height of posterior blade	250	216	—	—
Horizontal width of acetabulum	210 (?)	216	590	180-222
Height above middle of acetabulum	300 (?)	393	530	283-335
Height above pubic peduncle	420 (?)	457	770	392
Ischium:				
Middle of iliac suture to end	660	762	1110	—
Width across peduncles	210	—	360	—
Width across obturator process	245	210	—	—
Width near distal end	30	43	—	93-135
Thickness near distal end	18	18	—	—
Pubis:				
Length	1030	980	1320	680-740
Length of foot	600	563	600	370-465
Thickness of foot at midlength	140	106	260	—
Maximum thickness of foot	160	—	—	185-240
Girth of shaft above union	212	—	—	—

and diverge, causing a deep depression (maximum 65 mm.) which continues to the end of the foot and gives to this structure a spout-like appearance when viewed from in front. Below the point of union the antero-posterior diameter of the bones increases and the posterior edges become thinner and thinner, with a sharp depression between them as far as the point where the foot turns abruptly backward. Here, however, the two bones seem to be co-ossified and to form a median sharp edge along the superior aspect of the posterior part of the great distal expansion or foot.

The ventral edge of the foot is inclined up and back with respect to the axis of the bone, but it is practically parallel with the axis of the ilium or that of the whole trunk. Viewed ventrally the foot is thicker in front (160 mm.) and presents the form of a long isosceles triangle with the short base(anterior) excavated and the small angle (posterior) truncated and rounded.

HIND LIMB

The *femur* (Fig. 11) is not sufficiently well preserved to justify detailed description. The head is not revealed; the anterior trochanter is either crushed or but little developed; the fourth trochanter is high on the bone and moderately developed. The condyles are distinctly separated by a deep recess and they appear to turn back abruptly from the rather straight shaft instead of by a curvature of the bone as in the related genera.

The *tibia* (Figs. 12 and 13) is similar to that of *Gorgosaurus* or *Tyrannosaurus*, but the tibio-femoral ratio is 0.96, whereas it is 0.93 and 0.9 respectively for the other genera.

The bone is but slightly twisted, and is gently bowed outward. The proximal part is not greatly expanded. There is a distinct recess between the inner and outer tuberosities, and the tibial process is separated from the outer tuberosity by a deep excavation. The tibial process is very prominent, antero-internal in position, flattened, incurved, and continued downward on the shaft as a distinct flange. The outer tuberosity is outstanding, antero-external in position, and sharply

overhanging the constricted shaft beneath it. The cnemial process (175 mm. long) rises abruptly from the contracted shaft; it seems to be more pronounced than in *Gorgosaurus* and presents a flat, smooth surface in front and a concave, somewhat rugose surface behind for the reception of the fibula.

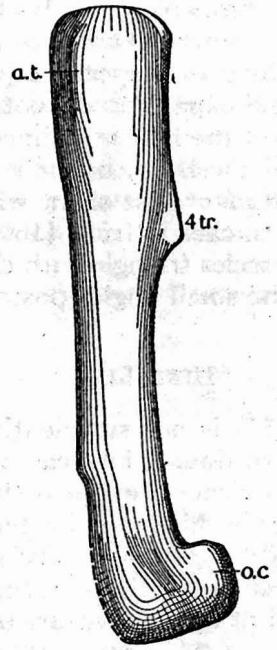

FIG. 11—Left femur, external view, 1/12 natural size. a.t., *anterior trochanter;* 4 tr., *fourth trochanter;* o.c., *outer condyle.*

On the anterior face of the bone, internal to the cnemial process, there is a pronounced concavity more or less continuous with the depression between the tibial process and the outer tuberosity. Lambe's figure of the tibia of *Gorgosaurus* does not show this downward extension of the cavity; it may be exaggerated by pressure in our specimen.

At midlength the shaft is subtriangular in cross section with the sharpest angle external, the medium internal, and the

widest posterior. The distal part of the fibula rests closely against the external angle of the shaft of the tibia.

The distal part of the tibia expands transversely in the usual manner and extends into two malleoli, of which the outer is the larger. The anterior face of the distal expansion

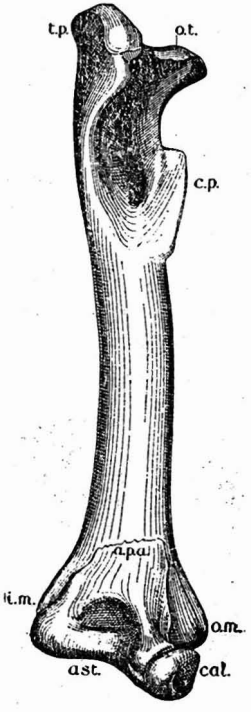

FIG. 12—Left tibia astragalus and calcaneum, anterior view, 1/12 natural size. t.p., *tibial process;* o.t., *outer tuberosity;* c.p., *cnemial process;* i.m., *inner malleolus;* o.m., *outer malleolus;* ast., *astragalus;* a.p.a., *ascending process of astragalus;* cal., *calcaneum.*

is excavated well up the shaft for the ascending process of the astragalus. Above the outer malleolus the anterior surface is slightly convex transversely, whereas it seems to be gently concave in the fragment ascribed by Lambe to *A. sarcophagus.*

The posterior face of the distal end shows the usual angulation with the postero-internal slope of less extent than the

postero-external. This inner slope is less abrupt than in Lambe's type, but, in view of the state of preservation, this feature may have no significance.

FIG. 13—Left tibia and fibula, proximal view, 1/12 natural size. ant., *antero-lateral;* T, *tibia;* F, *fibula.*

In Figure 12 the astragalus and calcaneum have been drawn as found; the bones are evidently displaced downward on the right of the figure.

The *fibula* (Figs. 13 and 14) is a long, slender, and simple bone, greatly expanded proximally and very little distally. The proximal expansion is thin, convex externally, and concave internally. The slope from the head of the expansion to the

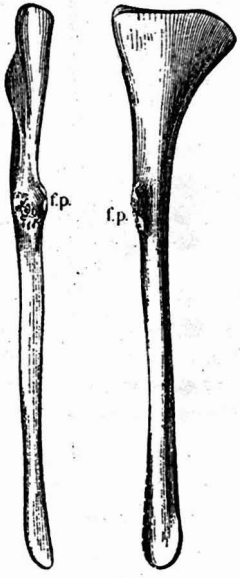

FIG. 14—Left fibula, 1/12 natural size. Left figure, anterior view; right figure, external view. f.p., *fibular process.*

shaft is evenly concave both anteriorly and posteriorly, but the anterior slope is very gentle, while the posterior is pronounced, thus giving the bone the appearance of being expanded almost entirely in the posterior direction.

The anterior margin of the expansion is interrupted, about 90 mm. from the proximal end, by a groove passing obliquely upward. About one-third down the shaft, its cross section is evenly convex externally and almost flat internally. Just below this point the anterior edge is greatly thickened and expanded into a rugose tuberosity (fibular process) which lies below and in line with the cnemial process of the tibia when the bones are articulated. Below this process the shaft is slender, flat internally, rounded externally and posteriorly, and with a thin edge anteriorly.

The flat internal side seems to become slightly concave toward the distal end, and the bone is bent slightly to fit over the outer malleolus of the tibia. The distal expansion is but slight, and is much less pronounced than in *Gorgosaurus* or *Tyrannosaurus*. The tibia and fibula are both in a good state of preservation and fit well together in their distal parts; the proximal expansion of the fibula, however, seems to be peculiarly related to the tibia as its antero-internal edge barely overlaps the tibia and its postero-external edge flares out widely (Fig. 13). In *Tyrannosaurus* and *Antrodemus* there is much more overlap, and in *Gorgosaurus* Lambe has figured quite a different relationship with the postero-external edge of the fibia overlapping the outer tuberosity of the tibia, and with its anterior edge divergent. These differences are marked, but it is very difficult to determine their actual significance as a slight twist or bend in either or both bones would have a pronounced effect on the relationship of their proximal ends.

The *astragalus* (Fig. 12) fits over the inner malleolus of the tibia, reaches across the hollow between the malleoli, and extends well out on the outer malleolus; it abuts against the calcaneum, and these two bones together have the same width as the distal expansion of the tibia.

Anteriorly the astragalus is continued upward in a long, flat process closely applied to the face of the tibia. The total length of this process is not revealed, but it could have been but little longer than shown in the figure. Above the articular surface the astragalus is deeply excavated transversely and is drawn out infero-externally for articulation with the calcaneum. The median part of the articular surface is destroyed making impossible a comparison with the peculiar rugosities figured by Lambe for *Albertosaurus sarcophagus*. On the posterior side the astragalus is not extended upward, but meets the tibia in an even line as in the other species.

There is no significant difference between the astragalus of the present species and that ascribed by Lambe to *A. sarcophagus*. The ascending process is a little wider, and the main part of the bone a little thicker.

The *metatarsus* is similar to that of the allied forms, having metatarsals II, III, and IV functional. *Tyrannosaurus* has metatarsal I developed in an upper and lower part, the latter diverging from metatarsal II as a separate element rising from a shallow groove; metatarsal V is absent. In *Antrodemus* metatarsal I is more continuous, and although small, is functional; metatarsal V is apparently absent. In *Gorgosaurus* the proximal part of metatarsal I appears to be absent and the distal part to arise from a marked protuberance on metatarsal II, metatarsal V is present as a short, non-functional bone. In the present species, metatarsal V is like that of *Gorgosaurus* and there is a raised, rugose surface on the rear of metatarsal II as if for the articulation of metatarsal I although no trace of that element has been found.

Metatarsals II, III, and IV are heavy bones so closely apposed for the upper four-fifths of their length that the contiguous surfaces are conspicuously flattened. Distally metatarsals II and IV diverge sharply from metatarsal III. Although metatarsal III is slightly shorter than in *Gorgosaurus*, both the outer and inner metatarsals are longer than in that genus.

Metatarsal II (Figs. 15 and 16) is shorter than metatarsal III, but about equal in length to metatarsal IV; it is strongly

expanded proximally with the greatest diameter antero-posterior, but slightly inclined out and forward. The outer surface of the expansion is flat or slightly concave toward metatarsal III. The anterior, posterior, and inner surfaces expand abruptly and concavely to the articular rim. The proximal articular surface is flat or slightly concave, and presents the outline of a low isosceles triangle, with the summit rounded and the sides somewhat excavated.

The shaft below the proximal expansion is sub-circular in cross section. About 100 mm. from the top is a strong tuberosity on the antero-external edge, about opposite a similar tuberosity on the antero-internal edge of metatarsal IV. Below this swelling the shaft is subquadrate in cross section, and about one-third from the proximal end an outer flat surface develops against metatarsal III. This surface gradually widens, turns inward and forward, and assumes an antero-internal to postero-external position. At about 150 mm. from the distal end, this flat surface represents the maximum diameter of the bone. Below this point there is an antero-external tuberosity below which the bone is inflected inward and expands to the articular surface.

The articular surface is greater than in metatarsal IV; it looks inward and is convex in both planes but more so antero-posteriorly, and shows vascular pits and canals. In outline the surface is subquadrate, rather convex in front and deeply indented behind between the condyles. Above the articulation is a lateral excavation internally, and a more pit-like excavation externally.

In lateral view the bone shows a slight bending, concave anteriorly, with the condyles directed backward, particularly the internal.

Viewed posteriorly, the most striking feature is a sharp, backwardly-directed, longitudinal ridge at midlength. External to this ridge the surface slopes sharply to the flattened external face; internal to the ridge, the surface is gently convex. This ridge presumably represents the place of attachment of the distal part of metatarsal I, but no trace of the

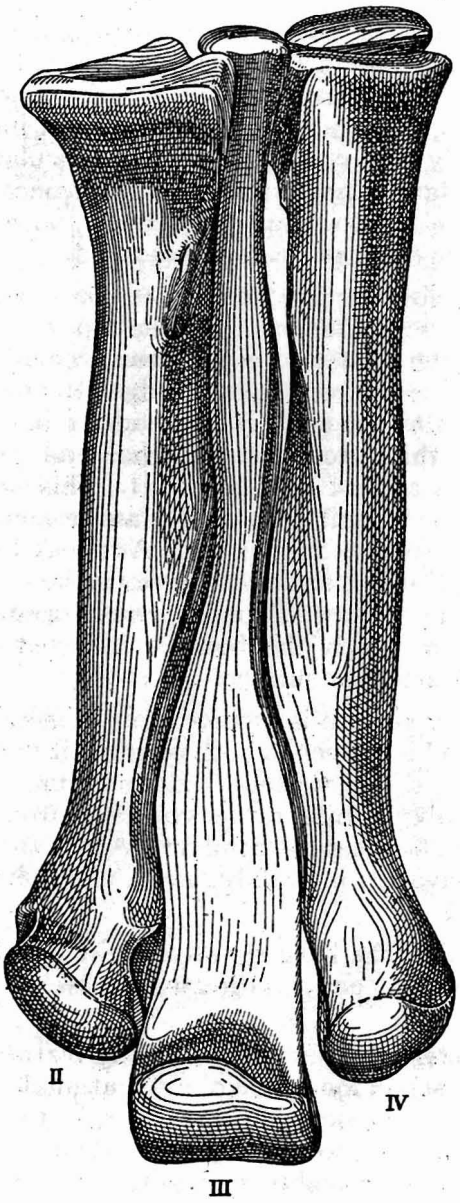

FIG. 15—Left metatarsus, anterior view, ¼ natural size.

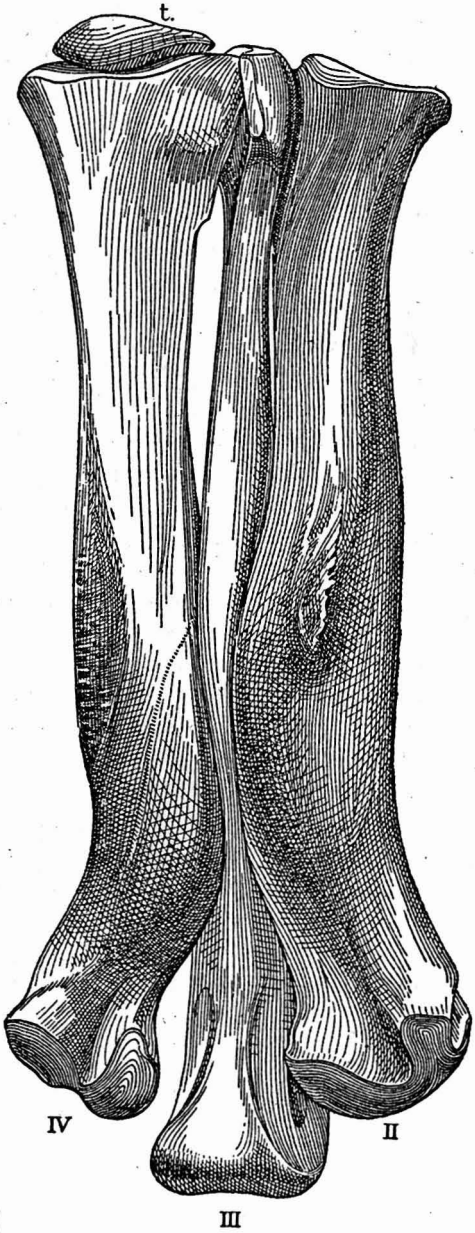

FIG. 16—Left metatarsus, posterior view, ¼ natural size. t., *distal tarsal.*

element has been found. The divergent distal end of the bone shows a strong excavation between the condyles.

Metatarsal III (Figs. 15 and 16) is longer than either the outer or the inner metatarsal; its proximal end is much reduced and laterally compressed, but it forms part of the articulation. Below this slight antero-posterior expansion, the shaft is small and sub-triangular in section, with one face against metatarsal II, but apparently not touching metatarsal IV in this region. Less than half way down, the bone becomes flattened antero-internal to postero-external, and comes into distinct contact with both the other metatarsals. The face against metatarsal II is more inclined than that against metatarsal IV, and these two bones almost pinch out metatarsal III posteriorly at about one-third of the length from the distal end. At the point where metatarsals II and IV diverge, metatarsal III rapidly widens posteriorly, but still remains of less diameter than the anterior face to the end of the bone. There is a deep pit on each of the lateral sides above the expansion.

The articular surface is trapezoidal in outline, narrower posteriorly; it is much more convex antero-posteriorly than transversely, and there is no distinct notch dividing the posterior part of the surface into condyles as in the inner and outer bones.

Anteriorly, metatarsal III is narrow and transversely convex from the proximal end to about midlength; this upper part is somewhat swollen or expanded in its central part, and presents, in consequence, a spindle-shaped outline. Below midlength the anterior surface widens greatly, becomes slightly concave transversely, and meets the lateral faces in sharp angles that are closely applied to metatarsals II and IV respectively. At the point of divergence of the inner and outer metatarsals, the anterior face of metatarsal III passes from slightly concave to slightly convex, and above the articular surface, shows a broad excavation.

Metatarsal IV (Figs. 15, 16, 17) is expanded proximally, apparently antero-internal to postero-external, but in Lambe's type of *A. sarcophagus* the expansion is in the opposite direction; in view of the crushed condition of this part of our bone it would probably be better to consider the disposition of this

expansion to be as in Lambe's type. This expansion, however, is much thicker than indicated by Lambe in his figure, as a considerable anterior point has been broken off. Antero-internally the proximal expansion is concave transversely for a length of more than 100 mm. in order to overlap the outer edge of metatarsal III. This flange-like, inner part of the expansion terminates distally in a sharp inflection to the line of the shaft causing a thin, prominent point on the inner posterior edge (not well shown in our bone, but clear in Lambe's). Below and anterior to this point is the callosity referred to below in the description of the inner aspect.

Below the proximal expansion, the bone is essentially triangular in section, flat behind, and sharply convex in front; it is not closely attached to metatarsal III. About half way down, however, the anterior convexity disappears, but the triangular cross section is even more pronounced, although differently disposed. In this region there is a broad, flat, internal face closely apposed to metatarsal III, a flat posterior face, and a somewhat convex, antero-external face. Near the distal end the bone is sharply deflected outward, and is ovate to subtriangular in cross section.

Viewed anteriorly this bone shows a strong longitudinal convexity below the proximal expansion; the external slope is longer than the internal, and meets the posterior face in a sharp angle both externally and internally. This anterior convexity continues for about two-thirds the length of the bone.

At about one-third from the upper end the antero-internal edge sweeps forward and inward in a long sigmoidal curve, thus bringing the internal edge to an anterior position in the lower part of the bone. There is a distinct longitudinal concavity between the internal edge and the gradually-fading, longitudinal convexity. Just below the point of divergence, the anterior face has become evenly convex from the antero-internal edge to the postero-external edge.

In posterior view this metatarsal is slightly concave on and below the proximal expansion, with sharp outer edges against the convex anterior face. At about mid-length, close

to the outer margin, is a long, roughened, bilanceolate groove, bounded in its upper half internally by a distinct raised edge against the proximal concavity, which continues down to mid-length of the groove.

Distal to this point, the posterior surface is slightly convex transversely, and concave longitudinally to the out-turned distal part of the bone. At the end, the bone is deeply notched between the condyles of the articular expansion. There is a light, narrow, depressed scar running up in a sigmoidal manner from above the outer condyle to the inner edge opposite the middle of the long, roughened, longitudinal groove. This feature is also shown by the metatarsus ascribed by Lambe to *A. sarcophagus*.

The internal face is thin and narrow below the proximal expansion, but at about 80 mm. from the top it expands into a pronounced callosity about 50 mm. long. Below this callosity the edge begins to flatten, and gradually becomes a wide, flat face against metatarsal III. In the distal, divergent part of the bone, this inner face becomes concave and is marked by a deep pit.

FIG. 17—Left metatarsal IV, distal view, ¼ natural size.

The distal articular surface is not greatly expanded, is evenly curved in both planes, and is marked by vascular pits and canals. The general outline is subquadrate, with a strong notch posteriorly where the bone is extended into two distinct condyles. Although the antero-external angle is crushed inward and, possibly also, the outer condyle backward, it seems impossible to overlook the differences from the corresponding part of Lambe's type of *A. sarcophagus*. The rugosities and protuberances so marked in Lambe's type above the

distal expansion are entirely absent. There can be no doubt of the specific identity of our form unless the peculiar condition of Lambe's bone is acribed to exostosis.

FIG. 18—Left metatarsal IV of *Albertosaurus sarcophagus*, distal view, ¼ natural size.

Metatarsal V (Fig. 19) is a short bone tapering to a point and evidently without phalanges; it is flattened laterally, and strongly curved forward (concavity in front). The external surface is flat to gently convex transversely. The internal

FIG. 19—Left metatarsal V, internal view, ¼ natural size.

surface is excavated at the proximal end by a broad rugose concavity to fit against metatarsal IV. Below this concavity is a raised, rugose, transverse ridge. About at mid-length the surface is smooth and gently concave, forming with the external surface an ovate section at this point. The distal,

tapering part of the bone is marked internally by a pronounced longitudinal ridge with a shallow concavity on each side to the end. The posterior edge is marked by strong rugosities from about mid-length to near the end. Distally this rugose surface turns toward the external side; in consequence, its full extent is not shown in the figure of the internal aspect.

This metatarsal is very like that described by Lambe for *Gorgosaurus*, but it is longer, heavier, and with a much greater curvature.

The only *phalanges* preserved are the proximal three of the third digit; these are normal and symmetrical and require no description beyond the measurements herewith.

While the measurements of the elements of the hind limb are in some cases doubtful, there can be little doubt that the distal parts (tibia, fibula, metatarsus) are relatively more elongate in the following order: *Tyrannosaurus*, *Gorgosaurus*, *Albertosaurus*. One of the best comparisons is that of metatarsus II to the femur—0.47, 0.5, 0.53. In *Albertosaurus* the phalanges are distinctly longer with respect to the metatarsals than in *Gorgosaurus*, the ratio of the first phalanx of digit III to the metatarsal being respectively 0.34 and 0.27.

COMPARATIVE MEASUREMENTS OF HIND LIMB

	Alberto-saurus mm.	*Gorgo-saurus* mm.	*Tyranno-saurus* mm.	*Antro-demus* mm.
Femur:				
Length	1020	1040	1300	645-850
Ant-post. diameter at midlength	118	136	180	72-95 (?
Width across condyles	???	—	340	145-182
Thickness of outer condyle	200	—	—	—
Girth at midlength	350	—	—	—
Tibia:				
Length	980	—	1140	690
Length with astragalus	1030 (?)	1000	—	—
Ant-post. diameter at midlength	73	—	—	—
Transverse width at midlength	115	—	—	—
Transverse width, proximal	215	—	—	210
Transverse width, distal	265	—	—	185

Fibula:				
Length	875	883	1025	623
Width, proximal	195	180	250	145
Width of shaft at midlength	42	47	—	—
Width, distal	55	50	130	59
Astragalus:				
Length	250	300	270	115-125
Maximum width	260	208	300	132-155
Ant. face of outer rotundity to posterior border	88	100	—	—
Ant. face median constriction to posterior border	65	80	—	—
Metatarsal II:				
Length	540	508	615	270-320
Width, transverse, proximal	85	—	—	60-67
Thickness, proximal	155	—	—	—
Width, distal	80	77	—	72-76
Metatarsal III:				
Length	590	594	680	327-353
Width, distal	88	92	140	80-80
Metatarsal IV:				
Length	558	546	600	275-324
Width, distal	65	65	—	57-65
Metatarsal V:				
Length	225	216	—	—
Width, ant-post., proximal	45	41	—	—
Thickness near upper end	30	27	—	—
Thickness near lower end	20	26	—	—
Phalanx III[1]:				
Length	200	163	—	110-116
Width, proximal	100	82		
Width, distal	90	—		
Girth, minimum	160	—		
Phalanx III[2]:				
Length	140	122		90-94
Maximum width, proximal	90	64		
Width, distal	70	—		
Minimum girth	135	—		
Phalanx III[3]:				
Length	100	93		66-74
Max. width, proximal	73	54		
Max. width, distal	58	—		
Tibio-femoral ratio	0.96	0.93	0.9	
Fibulo-femoral ratio	0.85	0.85	0.71	
Ratio, metatarsal III—tibia	0.6	0.6	0.6 (?)	
Ratio, metatarsal II—tibia	0.55	0.52	0.54	
Ratio, metatarsal II—femur	0.53	0.5	0.47	
Ratio, phalanx III[2]—metatarsal III	0.34	0.27	—	

ABDOMINAL RIBS

A number of abdominal ribs are present, but they are so scattered and broken and so displaced and buried under the dorsal ribs that neither the number nor order can be ascertained with any certainty. Following Lambe's determination of nineteen abdominal ribs in *Gorgosaurus*, the available bones in our specimen are provisionally arranged as in the table herewith.

Each rib consists of two parts—the rib proper, and a delicate, elongated, pointed "lateral" which lies in a long groove on the upper, anterior, distal part of the rib and extends beyond its end. The flattened heads of the ribs seem to be overlapping along the ventral line, but no constant method could be made out in the material available. Right rib 18, for instance, is constricted beyond the head, and the head itself is expanded and excavated on its proximal surface, as if for direct union with its fellow. Left rib 12 has a rounded, truncated, non-inflected, and thickened head quite different from those of the other elements.

One of the best preserved and most typical ribs is that which we have provisionally determined as Left 8 (Fig. 20). The proximal end is thin, narrow, and inflected backward,

FIG. 20—Eighth left abdominal rib, dorsal view, 1/6 natural size. a, *articular surface;* b, *groove for lateral.*

rugose at its tip and for a short distance along its convex anterior margin. Beyond the head is a thin, dorso-posterior flange that gradually passes to a ventral position distally and thus appears to pass diagonally across the bone. The main shaft thickens beyond this flange; it is convex behind, but in front forms a rather sharp edge superiorly. Below this edge begins the long groove for the lateral which continues for

265 mm. to the attenuated distal end becoming more and more superior in position.

The last rib (19) is double and the two halves are completely fused. The ventral (postero-ventral) side of the symphysial part is flattened with a diameter of about 25 mm. The superior side is also flat near the ventral line, but a median ridge gives it a biconcave cross section in the proximal region. The anterior concavity passes into the long groove for the lateral (230 mm.), which gradually rises to the superior position at the tip of the bone.

The anterior ribs seem to have an anterior as well as a posterior proximal flange and to maintain their width farther outward, thus presenting a resemblance to the dorsal ribs.

The laterals are all long, delicate, slightly curved bones with a maximum diameter of about 16 mm. in the anterior and 8 mm. in the posterior ribs. Their proximal ends are pointed and flattened, and their distal ends are pointed and round.

MEASUREMENTS OF ABDOMINAL RIBS

	Right mm.	*Left* mm.
No. 5, length	580 (?)	530 (?)
No. 7, length	—	520
No. 8, length	580	550
length of groove for lateral	—	265
width of proximal flange	—	40
width of shaft below flange	—	25
thickness of shaft below flange	—	14
No. 11, length	630	620
No. 12, length	—	500 (?)
No. 13, length	670	—
No. 15, length	600	—
No. 17, length	520	—
No. 18, length	480	480
No. 19, length	390	390
No. 5 lateral, length	—	300
width, maximum	—	16
No. 16 lateral, length	—	335
width, maximum	—	8

The *sternum* is probably represented by a flat, thin, semicircular bone found detached in the matrix. This fragment is provisionally interpreted as the left sternal element; it is 220 mm. long, 120 mm. wide, and about 20 mm. thick near the posterior end of the straight edge. The greater part of the bone is not more than 5 mm. thick, and the outer semicircular edge is quite thin. The internal surface is slightly concave and the external correspondingly convex.

PLATE I. — *Albertosaurus arctunguis*. The mount in the Royal Ontario Museum of Palæontology. About 1/20 natural size.